CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 8

RETAINING WALLS AND STEPS

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CHAPTER 8

RETAINING WALLS AND STEPS

8.00 GENERAL

The work covered in this Chapter shall include the construction of reinforced concrete retaining walls, and reinforced concrete steps.

Modular Block and Reinforced Earth Retaining Wall Systems shall be approved by the Engineer and shall meet the material specifications and be constructed according to the installation instructions provided by the manufacturer. In addition to the manufacturers specifications and installation instructions, these systems shall also include a wall location site plan certified by a licenced engineer, showing drainage volumes and overflow locations plus identifying soil types and adjacent loading conditions.

8.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1 Pavement Construction & Reconstruction
Chapter 2 Earthwork
Chapter 11 Portland Cement Concrete

8.02 MATERIALS

A. REFERENCE STANDARDS

1. ASTM C 90-75- Standard Specification for Loadbearing Concrete Masonry Units.
2. ASTM C 140-75 - Standard Specification for Sampling and Testing Concrete Masonry Unit and Related Units
3. ASTM D 638 - Standard Test Method for Tensile Properties of Plastic.
5. ASTM D 1248 - Standard Specifications for Polyethylene Plastics Molding and Extrusion Materials, for Wire and Cable.

B. CONCRETE

Unless otherwise specified, all concrete for reinforced, poured-in-place walls and steps shall be L3500 as described in Chapter 11 of these Specifications.

C. REINFORCEMENT

Reinforcement steel shall be free from excess rust, scale or other substances and shall be protected at all times from damage. All reinforcements shall be placed in the exact position shown in the plans, and shall be held securely in position by suitable means so they will not displace during the process of depositing or consolidating the concrete.

1. Reinforcement Bars

All reinforcement bars shall meet the requirements of "Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement", ASTM Designation A 615(A 615M), Grade 40 (300) or Grade 60 (420).

8.02 MATERIALS (Continued)

C. REINFORCEMENT (Continued)

2. Welded Steel Fabric

Welded steel fabric shall consist of sheets or strips manufactured for this purpose. The steel wire shall comply with the "Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement", ASTM Designation A 185. Intersecting members shall be rigidly welded at right angles in such a manner as to develop the full tensile strength across the weld. Steel fabric is specified on the plans by gauge and spacing of wires. The gauge number specified shall be in accordance with ASTM Wire Gauge Standards as given in the above reference.

3. Reinforcement Bar Supports

Reinforcement bar supports shall be of a satisfactory design and of sufficient strength to hold the metal reinforcement in place while the concrete is being placed.

D. PREFORMED JOINT FILLER MATERIAL

1. Bituminous joint fillers shall conform to the requirements for "Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)", ASTM Designation D 1751.

2. Sponge rubber and cork expansion joint filler shall conform to the requirements of "Standard Specifications for Preformed Rubber Sponge and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction", ASTM Designation D 1752.

3. Synthetic rubber or neoprene water stops of approved type shall be installed as indicated on the plans.

E. WATERPROOFING

Waterproofing shall conform to the “Standard Specification for Asphalt Used in Dampproofing and Waterproofing”, ASTM Designation D 449 Type I, or other commercially produced products intended for this use and approved by the Engineer. The provisions in the above-referenced Specifications relating to felt, asbestos felt, and cotton fabrics shall not apply.

Primer for use with asphalt in waterproofing shall conform to the “Standard Specifications for Asphalt Primer Used in Roofing, Dampproofing and Waterproofing” ASTM Designation D 41.

8.02 MATERIALS (Continued)

F. CURING COMPOUNDS

All curing compounds shall conform the requirements of Section 3.02.G. of these Specifications.

G. HANDRAIL

Handrail systems shall conform to "Standard Specification for Permanent Metal Railing Systems and Rails for Buildings", ASTM Designation E 985. Handrail shall consist of a rail element supported by metal brackets (wall type) or rail elements supported by posts (post type). Posts and rails shall be commercial quality structural steel tubing conforming to "Standard Specification for Carbon Structural Steel", ASTM Designation A 36. Brackets, bolts, nuts, washers and other fittings shall be commercial quality structural steel, except where shown otherwise on the plans.

Handrail shall be galvanized or painted to resist corrosion as approved by the Engineer.

8.03 REINFORCED CONCRETE RETAINING WALLS AND STEPS INSTALLATION

A. EXCAVATION AND BACKFILL

All earthwork shall conform to the requirements of Chapter 2 of these Specifications.

When called for on the Proposal, the established quantity of excavation (as provided in Chapter 2) shall include all earthwork necessary for the placement of the retaining walls and steps at the locations shown on the plans and cross sections.

When retaining walls or steps are called for on the Contract and no earthwork is bid on the proposal, all excavations and compacted backfill required for the completion of the retaining walls and steps shall be considered subsidiary to other items of work for which direct payment is made.

B. FORMS

Forms shall be of suitable material and of a type, size, shape, quality, and strength to insure construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist deflection during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor. All dirt, chips, sawdust, nails, and other foreign matter shall be removed completely from forms before any concrete is deposited therein. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes that would deface the finished surfaces. Forms previously used shall be thoroughly cleaned of all dirt, mortar, and foreign matter before being reused. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent which will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete.

8.03 REINFORCED CONCRETE RETAINING WALLS AND STEPS INSTALLATION (Continued)

B. FORMS (Continued)

1. BRICK FACED FORMS

Forms used for brick facing shall be cast aluminum or approved equal, unless otherwise specified by the Engineer. The forms shall have a simulated brick face and be of a size, type, shape, quality and strength to insure construction as designed.

2. SMOOTH FINISH FORMS

Forms requiring a smooth finish shall be fabricated of wood, metal or other approved materials to insure construction as designed. Wood forms shall be constructed and maintained to prevent warping and opening of joints due to shrinkage of lumber.

No direct payment will be made for forms. Forming shall be considered subsidiary to other items of work for which direct payment is made.

C. REINFORCEMENT PLACEMENT

When bending is required, it shall be done accurately without the use of heat, and bars having cracks or splits at the bends shall be rejected. Stirrups and tie bars shall be bent around a pin of not less than six (6) times the least dimension of the bar. Where there is a delay in depositing the concrete, the reinforcement shall be reinspected and, where necessary, cleaned.

All reinforcing steel shall be furnished in full length, except where splices are indicated in the plan or permitted by the Engineer. Splices in adjacent bars shall be staggered. Unless otherwise shown in the plans, bars shall be spliced by lapping the ends. Laps shall be a minimum length of thirty-six (36) bar diameters for Grade 40 (300) and twenty-four (24) bar diameters for Grade 60 (420) steel. Lapped splices shall be made by securely wiring the bars in contact, maintaining alignment and clearances.

BASIS OF PAYMENT

Payment for REINFORCING STEEL FOR STEPS AND RETAINING WALLS, IN PLACE, constructed in conformance with the plans and Specifications, and accepted by the Engineer, shall be based on the contract unit price bid per pound, based upon the quantity of reinforcing steel required for the Design Section, unless otherwise specified. No actual weighing of steel will be made. Such payment shall be full compensation for furnishing, bending, fabricating and placing the reinforcements; for all clips, spacers, ties, wire or other material used for fastening reinforcement, in place; and for all tools, labor, equipment and incidentals necessary to complete the work.

D. CONCRETE PLACEMENT

Before placing any concrete, all dirt and other debris shall be removed from the forms. Concrete shall be handled by methods which will prevent the separation or loss of ingredients and the formation of laitance. Concrete free fall distance shall not exceed 5 feet. This includes free fall in a discharge pipe when using a conveyor system for placement. Pumped concrete is not considered in free fall until the concrete exits the pumper hose. The concrete shall be placed in its final position, as nearly as possible, to avoid re-handling. The concrete shall be placed and thoroughly consolidated in level layers not exceeding 12 inches in thickness. Suitable means shall be provided to permit concrete to be placed in a manner which will avoid accumulations of dry or hardened concrete on the forms or reinforcement.

1. VIBRATING

All concrete shall be thoroughly consolidated by means of approved mechanical vibrators. The vibrator shall consolidate the full depth and width of the concrete to a uniform mass without segregation. Care must be exercised to insure the coating of all surfaces of the reinforcement with concrete and the thorough consolidation of concrete around the reinforcement. Equal care shall be taken to insure that all concrete is consolidated against the face of the forms.

No direct payment will be made for vibrating. Vibrating shall be considered subsidiary to other items of work for which direct payment is made.

2. SURFACE FINISH

After removal of the forms all smooth finished exposed surfaces of the concrete shall be rubbed starting as soon as conditions permit. Immediately before starting this work the concrete shall be thoroughly saturated with water. Sufficient time shall have elapsed before the wetting is done to allow the mortar used in the pointing of tie wire or tie rod holes and defects to be thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse Carborundum stone using a small quantity of mortar on its face. The grout shall be composed of cement and fine sand mixed in the proportion used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface finish has been obtained. The paste produced by this rubbing shall be left in place at this time.

The final finish shall be obtained by rubbing with a fine Carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color. After the final rubbing is completed and the surface dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks. Epoxy or latex sealant may be used in lieu of the above, with the approval of the Engineer.

8.03 REINFORCED CONCRETE RETAINING WALLS AND STEPS INSTALLATION (Continued)

D. CONCRETE PLACEMENT(Continued)

2. SURFACE FINISH (Continued)

After removal of brick-faced forms, all irregularities in the finish shall be corrected to the satisfaction of the Engineer. All tie wire and tie rod holes shall be pointed up with grout. All ridges at form joints shall be chipped off and pointed up. These and all other irregularities in the finish shall be made to match the configuration of the simulated brick surface, as nearly as possible.

No direct payment will be made for surface finish. The cost of the work required to provide the surface finish shall be considered subsidiary to other items of work for which direct payment is made.

BASIS OF PAYMENT

Payment for CONCRETE FOR STEPS AND RETAINING WALLS, IN PLACE, shall be based on the contract unit price bid per cubic yard, based upon the quantity of concrete required for the Design Section, unless otherwise specified. No actual measurement of the volume of concrete will be made. Such payment shall be full compensation for furnishing, preparing, transporting, delivering and placing all materials, except those for which the contract provides that direct payment shall be made, for work and materials for forms, falsework, bracing, etc.; incidental excavation and compacted backfill; and for all labor, equipment, tools and incidentals necessary to complete the work.

E. JOINTS

Joints shall be square and normal to the forms unless otherwise provided. Bulkheads shall be provided for all except horizontal joints. When shown in the plans or specified in the Special Provisions, joints shall be sealed.

1. CONSTRUCTION JOINTS

Construction joints shall consist of the joints in which no provision is made for movement of abutting surfaces. All construction joints shall be keyed and shall be made only where located in the plans, unless otherwise provided in these Specifications and approved by the Engineer. When not detailed in the plans, or in case of emergency, construction joints shall be placed as directed by the Engineer.

The surface of the hardened concrete shall be roughened as required by the Engineer, in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance, and saturated with water. A thin layer of grout shall be applied to the cleaned and saturated surface immediately prior to placing the fresh concrete.

8.03 REINFORCED CONCRETE RETAINING WALLS AND STEPS INSTALLATION (Continued)

E. JOINTS (Continued)

2. SURFACE FINISH (Continued)

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints which are exposed to view shall be carefully finished true to line and elevation.

2. EXPANSION JOINTS

Expansion and fixed joints shall be constructed according to the details shown in the plans. Expansion joints shall include those in which provision, in some manner or other, is made for movement by sliding or by deflection.

When preformed expansion joints are specified, the material shall be placed in correct position as the concrete on one side of the joint is placed. When the form is removed, the concrete on the other side shall be placed.

3. WATER STOPS

Water stops shall be furnished and placed as provided in the plans. They shall be synthetic rubber or other approved material. They shall form continuous watertight joints.

No direct payment will be made for joints or water stops. The construction of joints and water stops shall be considered subsidiary to other items of work for which direct payment is made.

F. WATERPROOFING

The back face of all retaining walls over 2 feet high shall be damp-proofed above the top of the footing. The surfaces to be damp-proofed shall be free from dust, sand, mud, mortar and other loose particles, all grease spots or marks of soil shall be removed by washing with an approved solvent.

After the surfaces have been thoroughly cleaned and dried, and if asphalt is the intended waterproofing, they shall be uniformly coated with one coat of primer and two coats of hot waterproofing asphalt.

The primer may be applied cold, but the asphalt shall be applied at a temperature of at least 250° F. Each coating shall be allowed to dry before the next coating is applied.

The primer shall be applied in quantities sufficient to thoroughly cover the surfaces to be treated. The waterproofing asphalt shall be applied at a rate of not less than 5 gallons per 100 square feet of surface.

8.03 REINFORCED CONCRETE RETAINING WALLS AND STEPS INSTALLATION (Continued)

F. WATERPROOFING (Continued)

If using other approved commercially produced products, the waterproofing shall be applied as per manufacturers specifications and directions.

Care shall be exercised to confine all damp-proofing materials to the area being treated and to prevent disfigurement of any exposed part of the structure by dripping or spreading of asphalt.

No direct payment for waterproofing will be made. Waterproofing shall be considered subsidiary to other items of work for which direct payment is made.

G. WEEPHOLE

Weep-holes shall be constructed in all retaining walls as shown on the plans or as directed by the Engineer.

No direct payment for the placement of weep-holes will be made. Placement of weep-holes shall be considered subsidiary to other items of work for which direct payment is made.

H. CURING AND PROTECTION

1. CURING

As soon after the completion of the specified finishing operation as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall be cured by the water method, the form-in-place method, or by the membrane curing compound method.

a. Water Method

The concrete shall be kept continuously wet by application of water for a minimum period of seven (72) hours after the concrete has been placed. Burlap, earth, or sand may be used as a curing medium to retain the moisture. The entire surface of the concrete shall be kept damp such that the concrete is covered with the curing medium.

b. Form-In-Place Method

Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of seven (72) hours after the concrete has been placed.

H. CURING AND PROTECTION (Continued)

1. CURING (Continued)

c. Membrane Curing Compound Method

All surfaces which are exposed to the air shall be sealed with a uniform application of a membrane curing compound applied at a rate of 1 gallon per 200 square feet of surface area. The curing compound shall be applied using an approved mechanical power sprayer of a size and capacity to complete the work. The curing compound shall meet the requirements of Section 3.02.G of these Specifications.

2. PROTECTION

The Contractor shall provide protective measures at their own expense to prevent damage to the work. The Contractor shall be responsible for any damage caused by the construction operation. Any concrete showing injury from vandalism shall be repaired or removed and replaced at the Contractor's expense.

No direct payment will be made for curing and protection. The cost of curing and protection shall be considered subsidiary to other items of work for which direct payment is made.

I. HOT AND COLD WEATHER CONSTRUCTION

Concrete work on retaining walls and steps shall not be performed during inclement weather except with specific permission of the Engineer. During hot or cold weather the work may proceed in accordance with Section 1.06 of these Specifications.

J. FENCE PLACEMENT

Fences shall placed along the tops of retaining walls where shown on the plans. These fences shall be constructed in accordance with the provisions of Chapter 9 of these Specifications.

K. HANDRAIL PLACEMENT

Handrails shall be placed at the locations and in accordance with the details shown on the plans, and as specified in these Specifications and the Special Provisions, and as directed by the Engineer.

The type of railing to be constructed shall be specified in the special provisions or shown on the plans.

The railing shall be erected true to line and grade. Posts shall be set vertical.
All welds shall conform to the latest requirements of the American Welding Society. All welds on exposed surfaces shall be ground flush with the adjacent surfaces.

K. HANDRAIL PLACEMENT (Continued)

All handrails, posts, and paint shall be of the size and materials as shown on the plans, Specifications, or as directed by the Engineer.

Primer paint shall be applied to a dry thickness of 2.0 to 3.5 mils and two (2) coats of enamel shall be applied to a dry thickness of 1.5 to 2.5 mils for each coat.

BASIS OF PAYMENT

HANDRAILS, COMPLETE, constructed in conformance with the plans and Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per foot, based on the total length of the top rail. Said payment shall be full compensation for the top rail, post or mounting brackets, erection, paint and all other tools, materials, labor and incidentals necessary to complete the work.

L. SUBSTANTIAL COMPLETION

Retaining walls and steps will be considered substantially complete when all steel and concrete is placed, cured, and finished, waterproofed, backfill completed, and handrail completed.